Simulation of TCP with Swift Start

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Overview

- Background
  - Slow Start
  - Swift Start
- Swift Start vs. Slow Start
- Simulation Setup
- Results

Slow Start

- Goal:
  - Determine how fast we can send data on an unknown network path

- Initial flight size of 1-4 segments (we use 4)

- Exponentially increases the congestion window (allowable amount of data to send)

Swift Start

- Developed by BBN and NASA
- Goal:
  - Do what slow start does, only faster
- Initial flight size of four segments
- Packet pair estimate is performed on the returning acknowledgements
- Estimate yields the bottleneck capacity
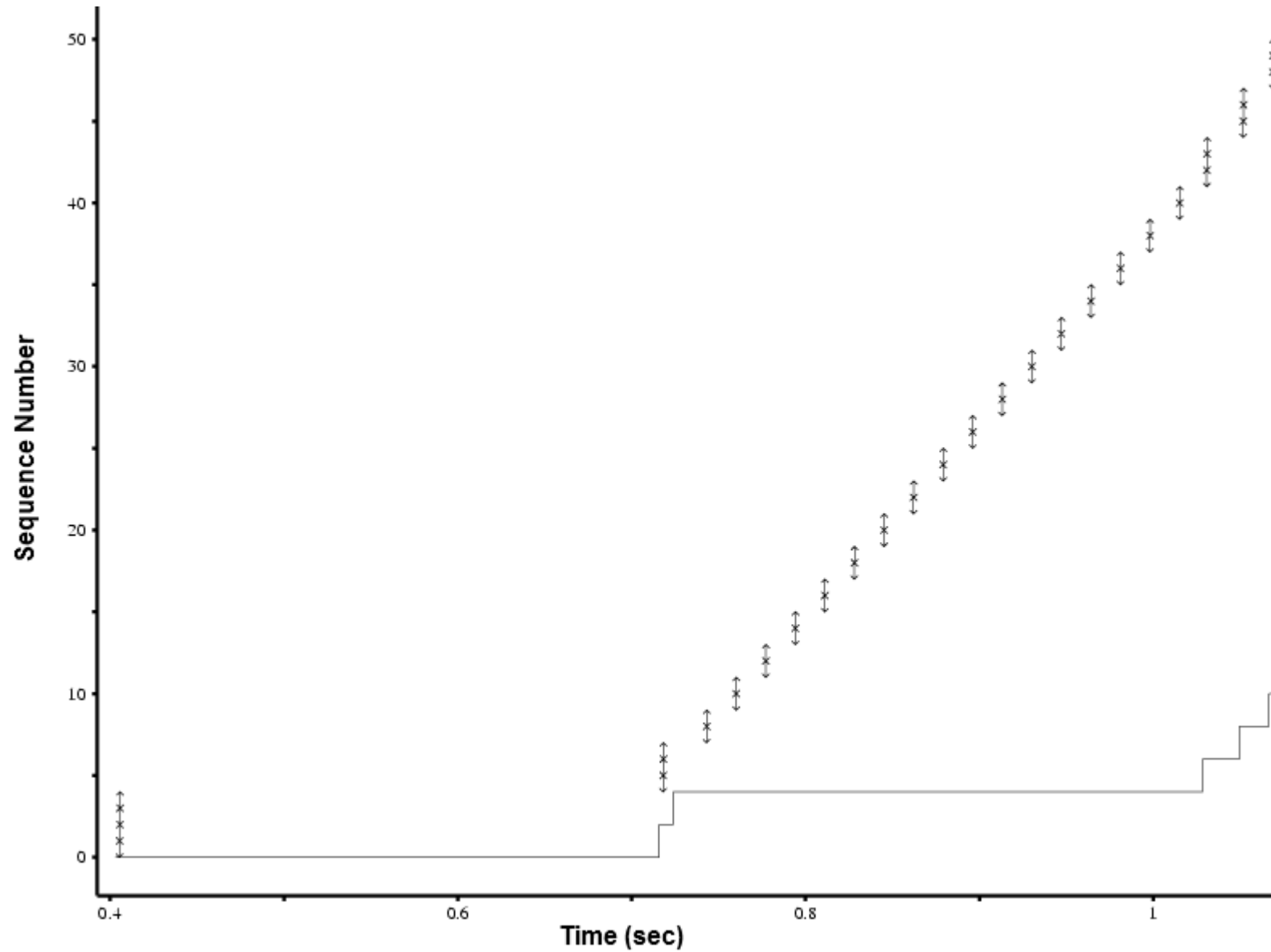
Swift Start (cont.)

- The estimate can be reduced by a scaling factor
  - Helps protect against over estimates
  - Keeps algorithm conservative
- Scaled estimate is used to increase the congestion window
- Since this amount may be large, the data is paced over the course of a RTT
  - Prevents large bursts
  - Reduces queuing requirements

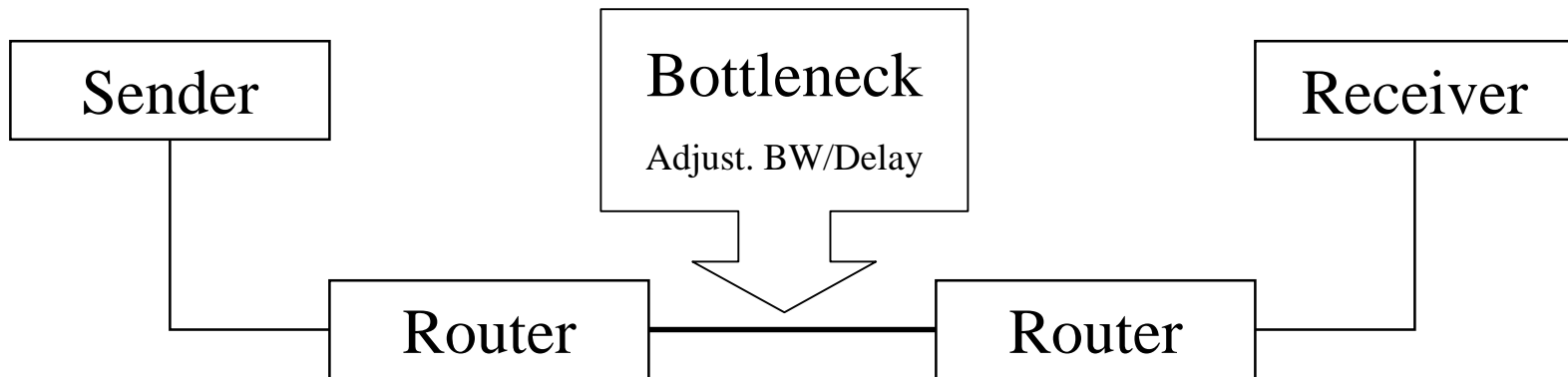# Theoretical Comparison
(Path with 30 segment capacity)

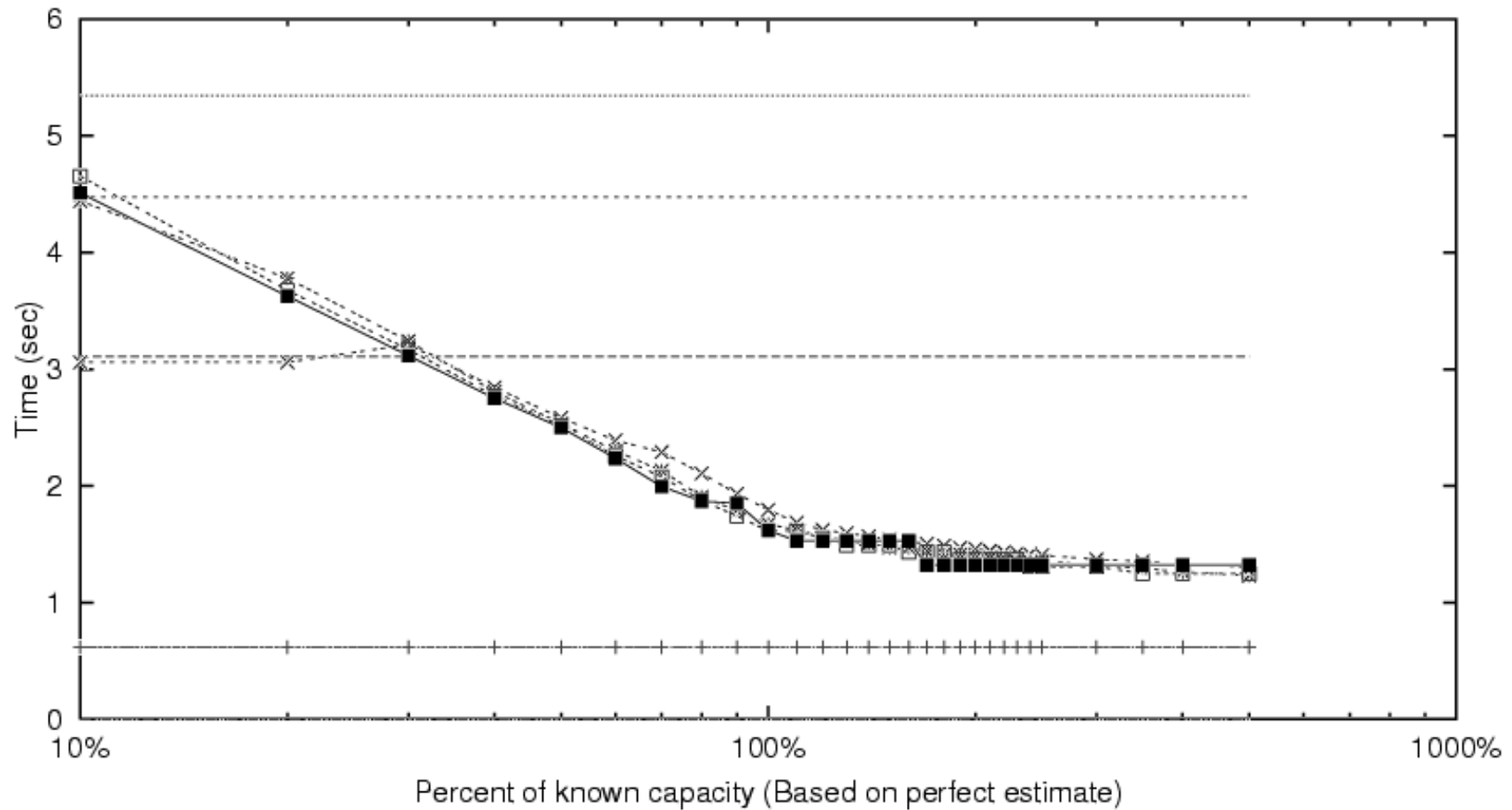| RTT	Slow Start	Swift Start Gamma = 1	Swift Start Gamma = 2
1	4	4	4
2	6	30	15
3	9		23
4	14		35
5	21		
6	32		

Pacing (Visual)

Simulation Setup/Topology

- NS Simulator (ns-2)
- "Sack1" TCP extended to support Swift Start

Router Queue Size: 25 segments

Results

Time to Utilize Full Capacity

Percent of known capacity (Based on perfect estimate)

Type: Bandwidth (bps), Delay (sec)

Slow Start: 50000, 0.250	Swift Start: 50000, 0.250
Slow Start: 500000, 0.250	Swift Start: 500000, 0.250
Slow Start: 1500000, 0.250	Swift Start: 1500000, 0.250
Slow Start: 3000000, 0.250	Swift Start: 3000000, 0.250
Slow Start: 10000000, 0.250	Swift Start: 10000000, 0.250

Effect of Continuing Pacing
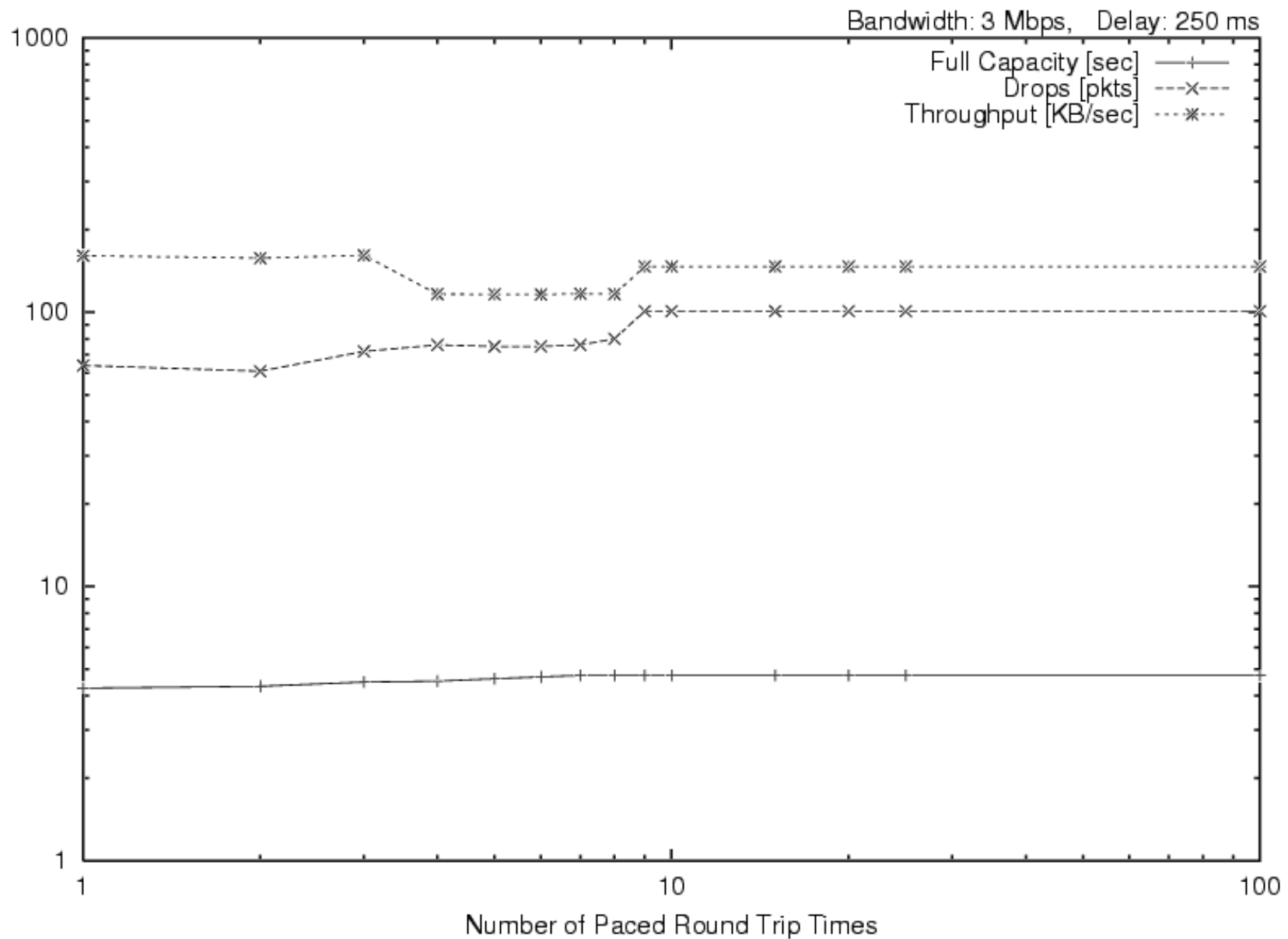
Conclusions

- Compared to Stock TCP
  - A Swift Start connection that takes a very small percentage of the bandwidth estimate (larger gamma):
    - Decreases the time need to reach full utilization on high capacity paths
    - Does not effect low capacity paths
    - Protects against over estimates
  - If the capacity estimate is accurate, decreasing gamma significantly decreases the time needed to reach full utilization
- Pacing longer shows little to no effect

Future Work

- Develop and test Swift Start with real hardware
  - Closed test bed (in progress)
  - Over the Internet and various paths
- How accurate is the packet pair estimate in real networks?
  - Researched heavily
  - Is the accuracy provided sufficient for Swift Start?
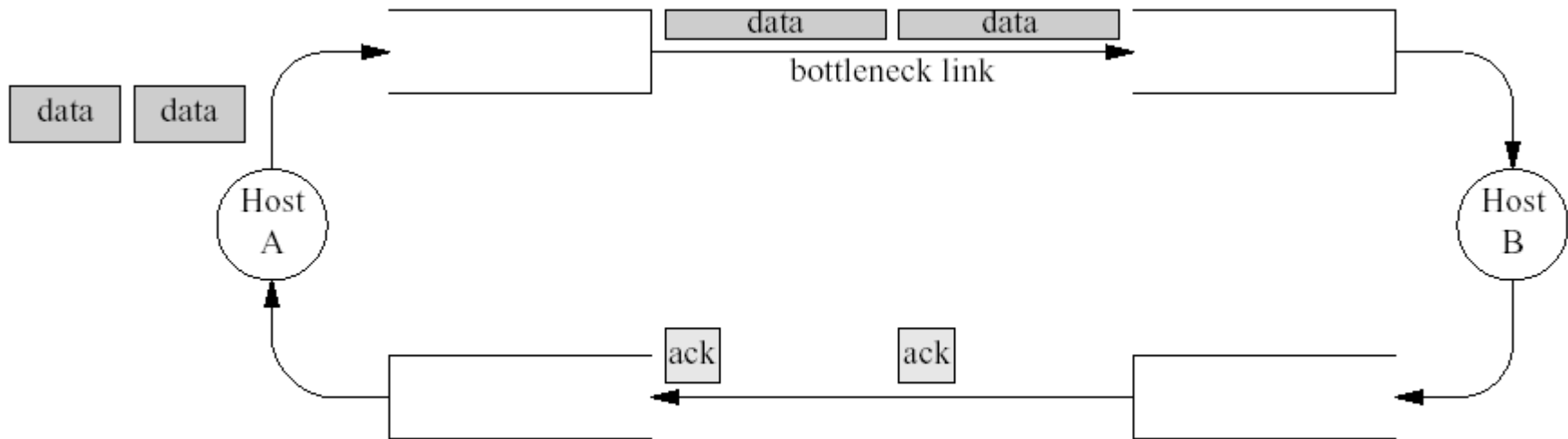- Swift Start concepts applicable to other areas of a TCP connection?

Supporting Slides

Packet Pair

Image from BBN Swift Start Report